GENERAL SCIENCE

Science Talent Institute

Forty boy and girl winners in the Fourth Annual Science Talent Search, during honor-trip to Washington, are addressed by leading scientists.

See Front Cover

➤ THE YEAR'S talented young scientists of America attended the five-day Science Talent Institute in Washington (March 1-5) as the culminating event of the Fifth Annual Science Talent Search for the Westinghouse Science Scholarships. This educational event is conducted by the Science Clubs of America, administered by Science Service.

This issue of SCIENCE NEWS LETTER reports some of the highlights of the sessions. The next issue will continue this report.

The picture on the front cover of this SCIENCE NEWS LETTER, by Fremont Davis, Science Service staff photographer, shows Dr. J. A. Hutcheson and a group of winners after his talk on "Radio Location and Radar," given before the Science Talent Institute.

Dr. J. A. Hutcheson, associate director of Westinghouse Research Laboratories:

Radar, the device that played many important roles in winning the war, will find countless more uses in peacetime. Originally radar was a device to detect enemy planes. By the end of the war, it was used to guide friendly planes to their targets, fire guns and direct searchlights.

Amazing and varied as have been the wartime applications of radar, the peacetime potentialities of the field still remain largely untouched, but ready for scientific exploration and expansion.

Considering that vacuum tubes for radio used during World War I have since been developed to perform such tasks as welding, controlling the speed of motors, opening doors and sorting products, the future applications of radar's electronic tubes are beyond the imagination.

Tubes with the circuits built inside them and other radar tools can be built in quantities rivalling the production of standard radio tubes.

Radar has extended the radio frequency spectrum by 100 times. The tubes and other components that exploit these fantastic frequencies are so vastly different from the concept of comparable prewar equipment that the possibilities of different combinations of the components have not been explored.

Thus, television and frequency modulation that incorporate many improvements are at hand. Color television and three-dimensional reception are within our grasp. And radar in its present form —to aid navigation, control airplane traffic and afford point-to-point communication as does the Army's famed "walkie-talkie"—poses only minor conversion problems for such uses in peacetime.

Dr. Marshall Stone, Harvard University:

➤ ONE of the very important factors in the rapid progress of science and technology is a firm command of higher mathematics. Everyone realizes quite clearly that the advance of modern science has come to depend upon the availability of well-organized laboratories, expensively fitted out with all kinds of specialized equipment, such as the cyclotron, the betatron, and the wind tunnel. Not everyone realizes so clearly that the advance of modern science depends upon the existence and exploitation of a large body of subtle, highly ingenious mathematics, which is continually expanding, thanks to the persistent efforts of professional mathematicians.

Some of the most spectacular contributions of mathematics to the advance of our scientific knowledge deserve to be cited in illustration of this fact. They will show us, if we look at them carefully enough, some of the reasons why mathematics plays such an important part in scientific research and development and also some of the limitations upon its powers. Suppose we begin by giving our attention to the physical phenomena of radio. The essential physical fact on which we rely is the fact that energy can be propagated by radio waves over very great distances. How did this fact come to be observed and understood in its minutest details, with the consequence that, in due course, we are now able to enjoy this marvelous facility of communications? Clerk Maxwell was the mathematical father of radio.

History records that this great English physicist of the nineteenth century, casting the laws of electro-magnetism as observed by Faraday into a unified mathematical form, deduced from their mathematical statement the logical consequence that wave-propagation of energy should be possible. Looking back, we can summarize Maxwell's achievement in a sort of syllogism: Faraday's laws are confirmed by experiment; Faraday's laws imply wave-propagation; hence wave-propagation can be confirmed by experiment. It was several years before the conclusion was verified by the German physicist Hertz, who set up a suitably designed experiment and obtained the confirmation desired. It is, of course, futile in one sense to explore the "might-have-been"—but are we not reasonable in imagining that, in the absence of a mathematical analysis like Maxwell's, physicists might not have looked systematically for this confirmation and might not readily have understood or appreciated the nature of such observations as they might have stumbled on by chance? An equally spectacular instance of the power of mathematical analysis in dealing with physical reality is a quite modern one, to which very little attention has been paid outside professional circles. This was the discovery of the positron.

The positron's discovery was made in the laboratory by the contemporary American physicist Anderson but—and this is what I want to emphasize—the stage for this discovery had already been elaborately set by the mathematical theories of the English physicist Dirac. Dirac's brilliant formulation of the laws of quantum physics led him to the logical conclusion that Nature's observed behavior is such as to allow the electron to have a hitherto unsuspected twin, of equal mass but opposite electrical charge. Thus, when Anderson's observations were made, more or less by chance in the course of experiments directed toward other ends, they could at once be fitted into the general picture without any misgivings as to their implications for physical theory. If we try to put Dirac's contribution ex post facto into a syllogism, it would perhaps run somewhat as follows: the fundamental laws of quantum physics, including those governing the electron, are confirmed; if the fundamental laws of quantum physics are correct, then both the electron and a twin particle, the positron, have equal logical claims to existence; hence, either the physical existence of the positron can be confirmed by experiment—or the fundamental laws of quantum physics must be supplemented by an additional principle or law which will have the logical effect of excluding the possibility of a particle like the electron.

A third spectacular example is Einstein's theory of relativity. Then there is Einstein's equation between mass and energy, deduced as a logical consequence of the physical principles of the special theory of relativity and published as long ago as 1905, which received experimental confirmation only a few years ago—and just now in 1945 received experimental and practical confirmation on so vast a scale as to become a matter of life-and-death interest to all the people of the world.

In a fundamental way mathematics is responsible for the atomic bomb. We cannot thoroughly understand the all-pervasive influence of mathematics upon the advance of other branches of science and technology by fixing our attention just upon the heroic achievements. Rather we must look to the more work-a-day relations, so little advertised, between mathematics and the different parts of scientific theory and practice. An adequate review would require more time than we have, so a few suggestive examples will have to suffice. It is, of course, in the great profession of engineering that we find the most practical and most familiar expression of modern science—and, at the same time, the commonest and most nearly indispensable applications of mathematics, particularly of its most anciently developed branches: geometry, algebra, and calculus. If we were to trace in detail the developments of the modern airplane, we should find it linked with the elaboration of a theory of flight, highly mathematical in character, which enables us to calculate the most useful shapes for wings, propellers, and other air-foils, and thus allows us to avoid expensive random experimentation in favor of well-directed experimental study of skillfully selected initial models.

Let's glance for a moment at the science of genetics, and we see the guiding influence of mathematical statistics at work upon the detailed development of those basic principles first noted by Gregor Mendel. By multiplying such illustrations we can fill in a picture in which the contributions of mathematics would be highlighted in almost every aspect of science. There are inner, natural reasons why mathematics is so inextricably woven into the development of science and technology. Nature, however mysterious, is at least not illogical, a principle which clearly encourages us to remain unsatisfied with mere observations upon the world about us and to proceed instead to reason about the facts established by observation. The application of reason or logic to the factual material derived from observation involves us at once in the use of mathematics, which is, after all, nothing more nor less than the art of precise, formal reasoning. The exhaustive study of the logical implications of the factual material of science marks out for us the limits between the possible and the impossible. Nature is in harmony with logic, and thus assists us through the refinements of mathematics to concentrate the costly efforts of experimental science and technology upon those enterprises which are calculated to be most promising or advantageous.

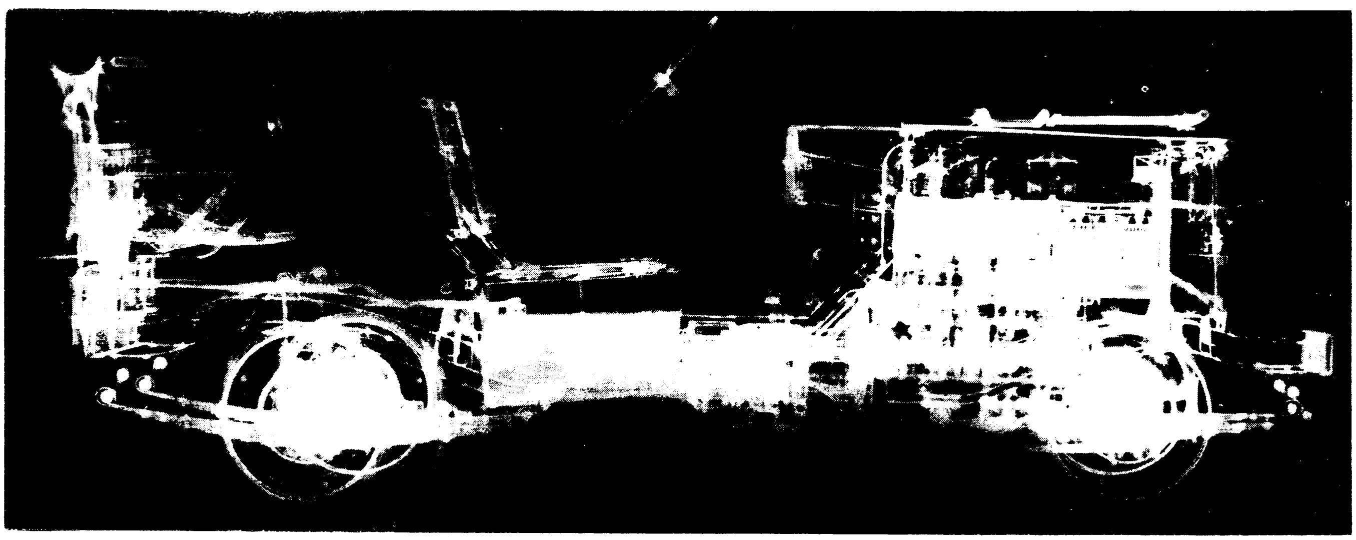
Science News Letter, March 9, 1946

MEDICINE

German Measles Danger to Unborn Babies Questioned

➤ FEAR THAT when an expectant mother has an attack of German measles, her baby may be born with cataracts, heart disease, deaf-mutism or other deformities may be relieved if further statistical studies bear out one reported in the *Journal of the American Medical Association* (March 2).

The fear arose from Australian reports, backed up by reports from American physicians, of the frequency of congenital malformations in the children when the mothers had German measles early in pregnancy. (*Turn to page 156*)



GHOST JEEP—This is the first radiograph of an entire automobile and was made by the Eastman Kodak Company and the University of Rochester. During a ninety-minute exposure, the X-rays had to penetrate the closed door of the laboratory, the atmosphere, and the jeep to record the image on film. The results show that almost every part of the jeep is visible, from the headlight filaments to the fuel level in the gas tank.